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EFFECT OF FOOD ON MILK.

FEEDING WITH FATS.

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EFFECT OF FOOD ON MILK.

FEEDING WITH FATS.

BY A. H. WOOD.

In previous investigations to determine the effect of foods upon the character of the butter product,* we found that gluten meal produced a very much softer butter than did corn meal. This result was hardly to have been expected, since gluten meal is a by-product from the manufacture of glucose from corn, and it might naturally be supposed that the butters would have the same general characteristics.

The fact that the gluten meal fed was very rich in oil (containing 18 per cent.), suggested the carrying out of an experiment to determine the effect of oils upon the quantity and quality of milk and butter.

In the course of the experiment the following were fed: cotton-seed oil, corn oil, palm oil, cocoanut oil, oleo oil, and stearin.

No difficulty was experienced in getting the cows to eat these oils in connection with their grain ration, and in several instances a decided liking for them was manifested. Three cows—Duchess, Princess Leto, and Maramee—were selected for the experiment. Their previous ration had been as follows, per 1,000 pounds, live weight:

Fifty lbs. ensilage, 5 lbs. mixed hay, 5 lbs. oat hay, 5 lbs. mixed grain (equal parts of cotton seed, gluten, and middlings), furnishing 2.45 lbs. of albuminoids, and 14.71 lbs. of non-albuminoids. Nutritive ratio,—1 : 6.

The cows were fed for two weeks upon a preparatory ration, containing none of the oils to be experimented with except what corn oil would be contained in 25 pounds of ensilage. This ration, which we will call ration A, was made up as follows:

* Bulletin 13.

		Albuminoids.	Non-Albuminoids.	
Ensilage, 25	lbs.,	.37	3.70	
Clover hay, 8	"	.62	3.58	
Vetch " 4	"	.37	1.51	
Ground oats, 4	"	.40	2.33	
Middlings, 4	"	.53	2.31	N. R., 1 : 5.9
		2.29	13.43	

In period two, palm oil was added to the ration of Duchess, corn oil to that of Princess Leto, and cotton-seed oil to that of Maramee—in all cases at the rate of 12 ounces per 1,000 pounds live weight. As fats are reckoned as two and a half times as valuable as other non-albuminoids, this addition widened the nutritive ratio to 1 : 6.8. We were able to obtain but a small quantity of corn oil, and the supply gave out after feeding ten days. Princess Leto then returned to Ration A for the remaining six days of period two. At the beginning of period three we were obliged to substitute clover hay for the four pounds of vetch hay previously fed, thus slightly widening the nutritive ratio to 1 : 6.9. Duchess now received stearin, and Princess Leto had oleo oil. Maramee was given cocoanut oil, but soon went off feed and was dropped from the experiment.

In period four, Duchess was fed cotton-seed oil and Princess Leto cocoanut oil. At the close of period four both cows returned to the ration which had been fed previous to the experiment. This they received until they went to pasture, May 30.

The milk from each cow was analyzed daily, and determinations of caseine were made by Mr. E. P. Stone, from a composite sample taken from the milk of the last five days in each period. At the close of each period milk from each cow was separated, the cream held in cold storage until the next day, and churned while still sweet. Analyses of the skim milks and buttermilks were made, and samples of butter reserved for examination. The comparative hardness of the butter was determined by Prof. C. L. Parsons, as described in previous papers. Chemical investigations of the butters were carried out by Prof. F. W. Morse, chemist of the station, the results of which appear in Bulletin 16. The separation of cream from the milk was effected with a DeLaval Baby Hand Separator, at a temperature of 90° F., with the exception of the lots of July 4, when the temperature was 85° F. The following table gives all the data of general interest:

DUCHESS.

Date.	Period.	Rations.	Nutritive ratio.	Average daily yield of milk, lbs.	Average per cent. of fat.	Per cent. of casein.	Average amount of fat in milk per day, lbs.	Churning temperature, deg. F.	Time of churning, min.	Fat in skim milk, per cent.	Fat in buttermilk, per cent.	Hardness of butter, m. m. of penetration.
February 25 to March 2	....	.....	1:6	29.15	4.10	3.14	1.20	.....	.....	.....	.....	.....
March 3 to March 15	1	A	1:5.9	27.68	4.43	3.20	1.23	48°-50°	70	.13	1.22	15.0
March 16 to March 31	2	A + Palm oil.....	1:6.8	28.81	4.52	3.03	1.30	48°-52°	38	.09	1.13	14.0
April 1 to April 15	3	A + Stearine	1:6.9	29.19	4.41	3.01	1.29	48°-50°	68	.15	.48	13.5
April 16 to April 30	4	A + Cotton-seed oil.....	1:6.9	29.43	4.11	2.99	1.21	50°-59°	35	.13	1.04	17.0
May 1 to May 29	5	.....	1:6	32.33	4.07	3.01	1.32	52°-58°	30	.17	.69	14.0
May 29 to July 4	6	Pasture	.....	30.23	4.58	3.16	1.38	54°	13	.26	1.36	.....

PRINCESS LETO.

February 25 to March 2	....	.....	1:6	19.37	5.12	3.22	.99	.....	.....	.....	.....	.....
March 3 to March 15	1	A	1:5.9	20.38	5.18	3.53	1.06	48°-64°	195	.08	1.13	7.5
March 16 to March 25	2	A + Corn oil.....	1:6.8	20.52	5.48	3.27	1.12	53°-54°	34	.13	1.00	9.0
March 26 to March 31	....	A	1:5.9	20.68	5.24	.....	1.08	51°-58°	100	.....	.78	7.0
April 1 to April 15	3	A + Oleo oil.....	1:6.9	21.58	5.19	3.35	1.11	50°-58°	300	.26	.48	6.5
April 16 to April 30	4	A +Cocoanut oil.....	1:6.9	20.67	5.34	3.40	1.10	50°-56°	340	.26	.87	5.7
May 1 to May 29	5	.....	1:6	22.55	4.89	3.29	1.10	52°-60°	90	.17	.34	8.0
May 30 to July 4	6	Pasture.....	.....	20.81	4.90	3.31	1.02	54°	15	.39	.78	.....

MARAMEE.

February 25 to March 2	....	.....	1:6	23.35	3.29	2.58	.77	.....	.....	.....	.....	.....
March 3 to March 15	1	A	1:5.9	23.82	3.22	2.89	.77	48°-52°	42	.14	1.30	16.0
March 16 to March 31	2	A + Cotton-seed oil	1:6.8	24.04	3.47	2.71	.83	48°-54° 51°-58°	90 95	.17	.61 .87	15.5 29.0
April 1 to April 12	3	A + Cocoanut oil.....	1:6.9	20.74	3.08	2.38	.64	.....	.....	.....	.....	.....

With Duchess, the change to ration A resulted in a decrease of 1.47 pounds of milk per day, and an increase in fat of .33 per cent. Princess gave an increase in milk of 1.01 pounds, in fat of .06 per cent. Maramee gave an increase of .47 pounds of milk, and a decrease in fat of .07 per cent.

Duchess (Ration A): Decrease in milk, 1.47 lbs.; increase in fat, .33 per cent.

Princess Leto (Ration A): Increase in milk, 1.01 lbs.; increase in fat, .06 per cent.

Maramee (Ration A): Increase in milk, .47 lbs.; decrease in fat, .07 per cent.

In period two, the addition of the oils resulted in each case in an increase of both milk and fat, as follows:

Duchess (A+palm oil): Increase in milk, 1.13 lbs.; increase in fat, .09 per cent.

Princess Leto (A+corn oil): Increase in milk, .14 lbs.; increase in fat, .30 per cent.

Maramee (A+cotton-seed oil): Increase in milk, .22 lbs.; increase in fat, .25 per cent.

During the last six days of period two, in which Princess Leto was again on ration A, she still further increased her yield of milk .16 pounds and reduced its fat, .24 per cent.

In period three, Duchess and Princess Leto both increased in milk and decreased in fat, while Maramee decreased in both milk and fat.

Duchess (A+stearine): Increase in milk, .38 lbs.; decrease in fat, .11 per cent.

Princess Leto (A+oleo oil): Increase in milk, .90 lbs.; decrease in fat, .05 per cent.

Maramee (A+cocoanut oil): Decrease in milk, 3.40 lbs.; decrease in fat, .39 per cent.

As before stated, Maramee went off feed about the middle of this period, and was dropped from the experiment. This explains her sharp shrinkage.

In period four, Duchess again gained in milk and shrank in fat, while Princess Leto shrank in milk and gained in fat.

Duchess (A+cotton-seed oil): Increase in milk, .24 lbs.; decrease in fat, .30 per cent.

Princess Leto (A+cocoanut oil): Decrease in milk, .91 lbs.; increase in fat, .15 per cent.

The return, in period five, to their regular ration was followed by a sharp increase in milk and a decrease in fat.

Duchess: Increase in milk, 2.90 lbs.; decrease in fat, .04 per cent.
Princess Leto: Increase in milk, 1.88 lbs.; decrease in fat, .45 per cent.

In period six, the cows were at pasture and both shrank in milk. Duchess increased in fat, while Princess Leto remained practically constant.

Duchess: Decrease in milk, 2.10 lbs.; increase in fat, .51 per cent.
Princess Leto: Decrease in milk, 1.74 lbs.; increase in fat, .01 per cent.

It would seem that the first effects of feeding oils was to increase the fat in the milk. Princess, in period one, averaged 5.18 per cent.; with the addition of corn oil her average for ten days was raised to 5.48 per cent., an increase of three tenths of one per cent. Omitting the oil, her average for the next five days fell to 5.24 per cent. Had similar results been reached with the other cows, as probably would have been the case had they all returned to ration A, and the experiment stopped at this point, it might have been said that it had been proven that adding fat to the ration increased the fat in the milk. But we notice that the sharp increase in fat was followed by a decrease, until the milk again nearly reached its normal condition. In period two, with palm oil, Duchess gave milk with 4.52 per cent. of fat; in period four, with cotton-seed oil, it fell to 4.11 per cent. We cannot say that this change was due to the change in oils, for in period two, Maramee, with cotton-seed oil, increased the fat in her milk from 3.22 to 3.47 per cent.

The addition of these oils to the cows' rations produced no objectionable qualities in the butter product. With respect to hardness, there are two variations that should be noticed: 1. The softening of the butter from Princess Leto when upon corn oil. The change was noticeable, not alone in the butter,

but in its quick churning. This change seems to be an explanation of the difference in the hardness of butters from corn meal and gluten, which is a by-product of corn. Corn meal contains about 4.50 per cent. of this oil, while the gluten from which we have obtained soft butters contains about 18 per cent., or four times as much as the corn meal. 2. The softening of the butter of Duchess when upon cotton-seed oil. With Maramee upon cotton-seed oil we got very unsatisfactory results, one sample taken March 27 showing very little variation from her previous butters, while another sample, taken four days later, proved to be remarkably soft. If it prove true, on further investigation, that cotton-seed oil does soften butter, it will show that cotton-seed and its meal contains something that not only offsets the tendency of its oil, but gives to the butter product of the cows fed upon it a remarkably firm texture.

We propose at some future time to make a much more thorough study of the effects of both corn oil and cotton-seed oil, with reference to their effect upon the character of butter.

The variations in per cent. of fat in buttermilk were quite wide, and although they are given in the table I will make no comment upon them, as the very small quantities of cream churned probably caused imperfect churning.

Now, in conclusion, I think that I may say that this experiment indicates,—

That the first effect of an increase of fat in a cow's ration is to increase the per cent. of fat in her milk;

That with the continuance of such a ration, the tendency is for the milk to return to its normal condition;

That the increase in fat is not due to the oils, but to the unnatural character of the ration;

That the results in this experiment tend to confirm the conclusions expressed in previous bulletins from this station, that the composition of a cow's milk is determined by the individuality of the cow, and that although an unusual food may disturb for a time the composition of the milk, its effect is not continuous.

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